

3/31/87

Quad Strengths for the DAW Linac
F. E. Mills

The DAW structure allows a quad of about 10 cm length every meter, either between cavities or in the input coupling region. If we use permanent magnets, we will probably be limited to a poletip field of 1 Tesla. If the bore tube has a 3 cm diameter, the poletip radius will be about 2 cm, so the maximum gradient will be 50 T/m. For a 200 MeV H⁻ ion, $B\rho \approx 2$ Tm, so the maximum K value (= $B'/B\rho$) is 25 m^{-2} . The RF field will defocus the ions with a K_r value given by

$$K_r = [\pi e TE_0 \sin\phi]/[\lambda \mu(\beta\gamma)^3] \approx .09 \text{ m}^{-2}$$

for $TE_0 = 7 \text{ MV/m}$, ϕ (measured from the peak field) = 30 deg, $\lambda = .37 \text{ m}$, $\mu = 938 \text{ MeV}$, $\beta\gamma = .7$

A matrix multiplication program (printout appended) was written to calculate β functions (maximum) and phase advances through such cells. The result is that a gradient of about 1/2 the maximum above is sufficient to attain $\pi/3$ per cell with a maximum β function of 4 m. The emittance should be about $7\pi \mu\text{m}/\beta\gamma \approx 10\pi \mu\text{m}$. Then the maximum amplitude is about 7 mm, which should fit comfortably in the bore hole, even with some misalignment errors. The RF defocussing is almost negligible, even at this large accelerating gradient.

Matrices DAW Linac Quads

1	2	3	4	5	6	7
1	Parameters	Matrix Elem.				
2	Input					Qf/2
3	Kf	12.50	T11	0.9844	M11	0.9844
4	Lf	0.05	T12	0.0497	M12	0.0497
5	kf	3.54	T21	-0.6217	M21	-0.6217
6	phif	0.18	T22	0.9844	M22	0.9844
7	Kd	-12.50	T11	1.0157	T11	1
8	Ld	0.05	T12	0.0503	T12	0
9	kd	3.54	T21	0.6283	T21	0
10	phid	0.18	T22	1.0157	T22	1
11	Kr	0.09	T11	1.0453	Det=	1
12	Lr	1.00	T12	1.0151	cosu	0.2862
13	kr	0.30	T21	0.0914	μ/π	0.3379
14	phir	0.30	T22	1.0453	beta	3.9969
15					alpha	0.0000

Matrices DAW Linac Quads

	8	9	10	11	12
1					
2	RF	Qd/2	Qd/2	RF	Qf/2
3	1.0453	1.0157	1.0157	1.0453	0.9844
4	1.0151	0.0503	0.0503	1.0151	0.0497
5	0.0914	0.6283	0.6283	0.0914	-0.6217
6	1.0453	1.0157	1.0157	1.0453	0.9844
7	0.3979	0.3760	0.3659	0.2936	0.2862
8	1.0512	1.1197	1.2232	3.7559	3.8298
9	-0.5600	-0.3188	-0.0875	-0.0581	-0.2397
10	1.0336	1.7102	2.4405	2.6629	0.2862
11	1.0000	1.0000	1.0000	1.0000	1.0000
12					
13					
14					
15					